

WELLS (WEL) National Estuarine Research Reserve
Water Quality Metadata
January-December 2006
Latest Update: October 2, 2019

I. Data Set & Research Descriptors

1). Principal investigator & contact persons:

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2). Entry verification:

The data are directly downloaded in the YSI-PC6000 format (as a .dat file) and the Comma Delimited format (as a .csv file) from the dataloggers to a PC laptop. The data are reviewed using the PC6000 software (Eco-Watch). Graphs and basic statistics are then generated with the Eco-Watch program and the information is viewed out for each data file. These graphs are used to determine any obvious data outliers and sonde and/or probe malfunction. All downloaded data files from the dataloggers (both raw unedited .dat and .csv files) are then transferred via disk to a Panasonic CF-28 where all files are reviewed and formatted for CDMO and stored. Here the raw unedited .csv data files are imported into Microsoft Excel 2005. After a complete month of data has been recorded, each file is ready to review, which requires several steps. The NERR CDMO Excel macros contained in the file "EQWinFormat.xls" are used for all data. Back up copies of all files are stored on a Maxtor One-Touch external hard drive, and the Wells NERR server.

The CDMO supplied macros are explained in the following quote from the CDMO NERR SWMP Data Management Manual (Version 5.1):

"The EQWin format macro will perform the following tasks:

- a) Automatically check that the parameters are in the correct order (see Chapter 6 Overview of data collection for correct order).
- b) Create a corrected timestamp column that reports the hours and minutes to the exact half- or quarter-hour and removes seconds.
- c) Convert depth values recorded in feet to meters.
- d) Format each parameter value to the correct number of decimal places.
- e) Assign the file an identifying station code."

Data is then put into a single Excel file, viewed, graphed and reviewed for discontinuities and any other anomalies. EQWin software is used to conduct further data checks, with the use of CDMO supplied queries. Anomalous data are investigated for validity based on field observations, instrument diagnostics and external checks by a YSI model 85 handheld. Data which are clearly erroneous are then removed from the data file, with deletions noted in section 12 below.

Data which appear to be anomalous but cannot be verified as such are left in the dataset, and documented in section 11 below.

The use of the Version 5.0 of the National Estuarine Research Reserve (NERR) CDMO System-Wide Monitoring Program (SWMP) YSI 6-Series Multi-Parameter Water Quality Monitor Standard Operating Procedures began in March 2004 when they became available. Data review and validation followed the subsequent CDMO NERR SWMP Data Management Manual (Version 5.1) released in December 2004. All Data QA/QC was performed by Jeremy Miller.

3). Research objectives:

The Webhannet River estuary is located in proximity to heavily used beaches in Wells, Maine. It has a shoreline that is highly developed with residential and commercial structures. The estuary receives water from a 14 sq. mi. watershed that is well forested. We are measuring variations in hydrologic variables in the Webhannet River estuary at the Head of Tide and at the Inlet. Data from Head of Tide will integrate surface and ground water inputs (from both point and non-point sources) from the freshwater watershed into the estuary. Data from the Inlet will integrate surface and ground water inputs from the freshwater watershed and the estuarine watershed. Differences in data between the Head of Tide and the Inlet will indicate inputs from the estuarine portion of the watershed (on the ebb tide), and inputs from the Gulf of Maine on the flood tide. The instruments will track runoff events via salinity, and will measure pollutant-carrying sediment particles via turbidity. Our working hypothesis is that the freshwater watershed is the primary source of sediment and therefore potential NPS pollutants in the estuary. These two variables will indicate the potential for non-point source pollutants to enter the estuary, and whether they are of upland, estuarine, or Gulf of Maine origin. Other variables measured by the data loggers (DO, temperature, pH, specific conductivity, and water level) will provide important baseline data to track changes in the estuary's physicochemical parameters over the long term. These variables can be affected by changes in human water use, and by natural or human induced changes in Inlet and river channel morphology, climate, and organic loadings. The Inlet site is heavily impacted at the Wells Harbor dock and is our long-term monitoring site. The Head of Tide site is relatively un-impacted, located just east of the US Route One Bridge, and is our roving site. We also collect data at the Skinner Mill site (SM) which acts as the head of tide site for the Little River/Merriland river estuary and at the mouth of the Little River (LM) to have comparative data for a less developed estuary.

4). Research Methods

The Wells NERR YSI monitoring program began in April 1995 at one site (Head of Tide site-HT) and May 1995 at a second site (Inlet site-IN) in the Webhannet River estuary. Two additional sites were added in 2002, Mile Road (ML) site began in March in the Webhannet River estuary and Little River Mouth (LM) in April in the Merriland/Branch/Little River Estuary. For 2004, the Mile Road (ML) site was eliminated and a new site at Skinner Mill (SM) in the Merriland/Branch/Little River Estuary was added. All data loggers have 1/4 inch black vexas mesh wrapped on the outside of the probe protective housing (using rubber bands) of the sonde guard to prevent fouling and unwanted animals. All deployment structures (PVC tubes) described below, are labeled with the Wells NERR information.

*IMPORTANT CHANGE TO ALL SITES: In 2004, the YSI Extended Deployment System was used for all deployments. This system consists of a small brush that sweeps all

the probes (except for depth) prior to each reading, greatly reducing the problem of biofouling. The Extended Deployment System is reflected in the "EDS" in the sonde model number.

* IMPORTANT INFORMATION PERTAINING TO THE INLET (IN) SITE:

The Inlet site (IN) deployment methods are different than the other sites (SM, HT, LM), due to the installation of a YSI telemetry unit in 1998. A 23 foot, 4 inch diameter high grade PVC tube was installed against a dock piling. Four steel flat bars with bolts were used to attach this 23 foot PVC tube against the dock piling. A 3 by 1.5 inch PVC transducer was glued on the inside bottom of the PVC tube to allow the sonde to sit exactly 1.0 meter (3.28 ft) off the bottom. Several vertical holes, representative of the sonde guard, were cut out the circumference near the bottom of the PVC pipe to allow water flow to the probes. An "L" shaped steel bar with two end-holes is placed through two created slits about a half of foot from the top of the PVC tube. A stainless steel wire (1/16") is attached to the sonde bail using two stainless steel clips; and to one end of the "L" shaped steel bar for sonde deployment and retrieval. A marine lock is attached through the other end of the "L" shaped steel bar to hold the bar, wire, and sonde in place and for security. A PVC threaded cap screws in to the threaded top of the PVC tube, also for security. A hole was created in the PVC cap to allow the sonde to hook up with the telemetry unit using the 50 foot vented cable. The telemetry unit was removed in 2004 and is no longer in service at this site.

* IMPORTANT CHANGE TO THE SKINNER (SM) SITE:

On 5/30/2006 the location of the Skinner Mill (SM) was changed to better reflect a head of tide and head of estuary scenario. The site was moved approximately 100 meters downstream from the original site described below. In addition, a Sutron Sat-Link2 transmitter was installed at this station, and transmits data to the NOAA GOES satellite, NESDIS ID #3B035008. The transmissions are scheduled hourly and contain four (4) datasets reflecting fifteen minute data sampling intervals. The telemetry data is "Provisional" data and not the "Authentic" dataset used for long term monitoring and study. This data can be viewed by going to <http://cdmo.baruch.sc.edu>."

All other sites, Head of Tide (HT), Little River Mouth (LM), and Skinner Mill (SM) are deployed similarly to each other as of 5/30/2006. These sites use a 5 foot, 4 inch diameter high grade PVC tube. The PVC tube is attached to a 12 foot, heavy steel sign post using a stainless steel bolt at the bottom of the tube, a stainless steel cable wrap at the top, and several thick electrical cable ties in between. The steel sign post was pounded in about 6 feet into the river bottom, such that the bottom of the PVC tube was flat on the river bottom. The PVC tube has one 3 by 1.5 inch PVC transducer glued on the inside bottom of the PVC tube to allow the sonde to sit exactly at a certain height off the bottom (see below). Several vertical holes, representative of the sonde guard, were cut out the circumference near the bottom of the PVC pipe to allow water flow to the probes. An "L" shaped steel bar with two end-holes is placed through two created slits about a half of foot from the top of the PVC tube. A stainless steel wire (1/16") is attached to the sonde bail using two stainless steel clips; and to one end of the "L" shaped steel bar for sonde deployment and retrieval. A marine lock is attached through the other end of the "L" shaped steel bar to hold the bar, wire, and sonde in place and for security. A flotation buoy is tied to the PVC tubes incase the deployment structure ever gets dislodged. The deployment depth for these sites is such that the probe-end of the data logger is secured 0.15 meters (6 inches) off the bottom.

Deployment and Data Intervals:

Two to four week variable sampling periods were chosen for all data sondes due to limitations created by the life of the dissolved oxygen membrane, probe fouling, limited battery power, and to minimize risk of lost data in the event of a malfunction. Measurements of temperature, specific conductivity, salinity, percent saturation, dissolved oxygen, depth, pH, and turbidity are recorded at 30 minute intervals throughout the deployment period.

Calibration and Standards Used:

After the deployment period, the data logger is brought back into the Wells NERR Laboratory for downloading, cleaning, and calibration. These procedures are carried out to the methods described in the YSI Operating Manual. Calibration standards are used for specific conductivity (10 mS/cm), pH (buffer solutions of pH 4, 7, and 10), and turbidity (123 NTU). The pH standards are purchased from Fisher Scientific. Conductivity and turbidity standards are purchased from YSI, Inc. The dissolved oxygen membranes are replaced and sit 6-24 hours before each deployment. During periods when we have an idle YSI logger, the deployments are continuous (retrieved logger is immediately swapped with a newly deployed logger). If no idle logger is available (for example, it is away for repair), after approximately 6-24 hours of down time for cleaning, maintenance and recalibration, the YSI Data logger is redeployed for another sampling period.

QA/QC of Instruments:

At each deployment and retrieval, a YSI Model 85 handheld unit collects temperature, DO mg/L, DO %, and salinity. These parameters are recorded on the calibration/deployment/retrieval data sheets and compared to the sonde data. In addition, at the end of each deployment, the data is immediately downloaded and a graph viewed of the data to look for periods of missing or anomalous data. "Post-calibration" data (using calibration standards) are also recorded, to verify that the probes are still measuring accurately after retrieval. available.

5). Site location and character

The Wells National Estuarine Research Reserve is located in York County, within the Town of Wells, on the coast of southern Maine and faces the Atlantic Ocean. The Wells NERR is approximately 31 km (20 miles) south of Portland, Maine and 110 km (70 miles) north of Boston, Massachusetts. The Reserve encompasses 1,690 acres along the Gulf of Maine coastline of tidally-flushed wetlands, riparian and transitional upland fields and forests within the Little River Estuary and the larger Webhannet River Estuary. Both estuaries arise in the sandy glacial outwash plain about eight miles inland. Both rivers empty into Wells Bay, a sandy basin stretching for approximately ten miles along the Atlantic coast. Bordering each river's Inlet are double spit barrier beaches attached to the mainland. The backbarrier system in the Webhannet River Estuary is approximately 5 sq. km and is composed of large intertidal marshes (predominantly *S. patens* and *S. alterniflora*), intertidal sand and mud flats, and tidal channels. The watershed for the Webhannet River estuary covers an area of 35 sq. km and has a total of 6 streams, brooks or creeks, which enter the estuary. These tributaries flow across sand and gravel deposits near the headwaters and the impermeable sandy muds of the Presumpscot Formation in the lower reaches. The watershed for the Little River estuary covers an area of 84 sq. km and has a total of 2 tributaries. The backbarrier system in the Little River Estuary is approximately 2.51 sq. km and is composed of large intertidal marshes (predominantly *S. patens* and *S. alterniflora*), intertidal sand and mud

flats, and tidal channels. The Webhannet River is connected to the ocean via Wells Inlet, which has a spring tidal prism of 28,200,000 cub. m (Ward 1993). The Little River is connected to the ocean by an unstructured, double spit system and is one of the few tidal Inlets along the southern Maine coast that is not stabilized by either natural outcrops or artificial jetties. The force and volume of tidal action affect the salinity level of both rivers. In the Wells region, the annual mean wave height is almost 20 inches. These estuarine systems are dominated by semi-diurnal tides having a range of 8.5 to 9.8 feet. The volume of freshwater influx into both estuaries is moderate to low (on the order of 0.5 cubic meters/second), especially in the summer, because of the rivers' relatively small drainage areas and the presence of deep glacial deposits. The relatively low flows from these two rivers taken in with the 20 inch per year average runoff of the area surrounding the estuaries combine to form a fresh water flow which is dwarfed by tidal flushing. Twelve-foot tides dwarf the freshwater flow into the Webhannet estuary, which has a drainage area of 14.1 square miles. The Merriland River and Branch Brook meet south of Route 9 to form the Little River which drains an area of 10.75 sq. miles. The Webhannet estuary, fed by both Blacksmith and Depot Brooks, is adjacent to the harbor and greatly developed land. It offers a valuable opportunity for comparison with the relatively pristine Little River estuary. The land use of the Webhannet estuary include a total of 15% for wetland, fresh water, and tidal marsh; a total of 63.7 % for woodland; and a total of 18.6% for developed land compared to a total of 5.7% development in the Little River estuary (WNERR RMA 1996; Holden 1997).

The following information regarding annual weather patterns in the area was supplied by Maine State Climatologist Professor Gregory A. Zielinski extracted from "Monthly Station Normals of Temperature, Precipitation, Heating and Cooling Degree Days 1971-2000", Climatology of the United States No. 81, National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC. and "Daily Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000", Climatology of the United States No. 84: "Average monthly temperatures range from 21.6F in January to 66.7F in July with daily highs averaging just below freezing in January and lows around 11F. Daily highs in July average around 76F and daily lows around 57F. The sea breeze often keeps daily highs lower during the summer than areas inland. Annual average temperature is 44.6F. Annual precipitation is 47.07 inches, including the water equivalent of snowfall, with monthly averages ranging from 3.01 inches in July to 4.77 inches in October. August receives just 3.02 inches on average. Annual snowfall is around 66 inches." According to Zielinski, "cool ocean temperatures keep down the number of afternoon showers and especially thunderstorms resulting in low summer precipitation amounts."

There are two sampling sites in the Webhannet River estuary. These are located at the Head of Tide (HT) and at the Webhannet Harbor Inlet (IN). The tidal range at each of these sites is 2.6-2.9 meters.

The Head of Tide site (43 deg 17' 54.25227" N Latitude, 70 deg 35' 13.82728" W Longitude) is located 4 miles south of the Wells Reserve, just downstream of the Webhannet Falls (freshwater) and 10 feet east of U.S. Route One. U.S. Route One is used heavily by traffic all year, especially during the summer tourist months. This site has soft mud, sand, and a rocky substrate, and the low and high tide depth is relatively shallow. Depth at mean high water is 1.1 meters. Max and min measured depths are 0.2 to 1.6 meters, giving a max tidal range of 1.4 meters. The salinity range here is 0-31 ppt, with a mean of 3.6 ppt. These headwaters of the Webhannet are relatively undeveloped. This site is located just 10 feet east of the U.S. Route One bridge, and is our roving site.

The Skinner Mill (SM) site is located approximately 100 meters downstream from the intersection of the Merriland River (tributary to Merriland/Branch/Little River estuary) and Skinner Mill Road (at 43.34533 degrees north and -70.552094 degrees West). This site is approximately 70 meters downstream from the Watershed Evaluation Team (Educational water quality program at Wells NERR) site L5. Substrate is mud/sand bottom, salinities range from 0 ppt on low or outgoing tides and as high as 27ppt on high tides. Max and min measured depths are 0.1 to 1.9 meters, giving a max tidal range of 1.8 meters. Depth at mean high water is 1.3 meters. Data prior to 5/30/2006 is from the original SM site located approximately 70 meters upstream from the current site, which is approximately 20-30 meters beyond the head of the estuary where mixing between fresh and marine waters occur. Please see the 2005 Water quality metadata for a better description of the original site.

The Inlet site is located 1.5 miles south of the Wells Reserve, at the Wells Harbor pier (43 deg 19' 12.44804" Latitude, 70 deg 33' 13.82728" Longitude). The mouth of the Webhannet estuary forms an extensive wetland/salt marsh area which is surrounded by development. Wells Harbor, which was most recently dredged in 1971, has moorings for approximately 200 commercial fishing and recreational boats. The mouth of the river flows between two jetties to the Atlantic Ocean. This channel was dredged in 1974. This site has a predominately sand substrate and is characterized by strong current during incoming and outgoing tides. Max and min measured depths at the Inlet site are 1.2 to 5.9 meters, giving a max tidal range of 4.7 meters. The salinity range here is 7-35 ppt, with a mean of 31 ppt. The Inlet site is heavily impacted at the Wells Harbor dock and is our long-term monitoring site.

The Little River Mouth site is located 0.4 miles from the Wells Reserve. Due to problems with heavy sediment movement in the Inlet of the Little River, we were forced to relocate the site (see 2002 metadata). We designated a new location for the 2003 sampling season, and it has remained since then. It is located just off the bank of the marsh, in the main channel of the river (N 43 deg 20.413 Latitude, W 70 deg 32.441 Longitude). The first location attempted in 2002 (N 43 deg 20.176 Latitude, W 70 deg 32.497 Longitude) was located in the main channel of the river, just inland of a spit, beside a bank. The second location attempted in 2002 (N 43 deg 20.083 Latitude, W 70 deg 32.585 Longitude) was located 1/8 mi. southwest of the first site, within an Inlet, just inland of a spit. The second site was located in an area of much lower current than the first site and often drains completely during low tides. It was also placed within a pool next to incipient low marsh peat that retains calm water during low tides. Max and min measured depths at this site are 0.3 to 2.4 meters, giving a max tidal range of 2.1 meters. The Little River sites exist in a shallow and relatively pristine system with a sandy to mud bottom and a salinity range of 0-32 ppt. There are two major freshwater inputs, the Merriland and Branch Brook Rivers, which converge to form the Little River.

6). Data collection period:

Deployment and retrieval dates and times, model YSI 6-series sonde used for 2006:

BEGAN	ENDED	SONDE MODEL
Inlet Site (site code: IN)		
12/14/05, 10:00	01/05/06, 15:30	6600EDS-SV
01/06/06, 16:00	01/19/06, 13:30	6600EDS-SV
01/19/06, 16:30	02/02/06, 13:30	6600EDS-SV

02/02/06, 14:00	02/15/06, 11:30	6600EDS
02/15/06, 12:00	03/06/06, 15:30	6600EDS-SV
03/06/06, 16:30	04/24/06, 09:00	6600EDS-SV
04/25/06, 09:30	05/23/06, 09:00	6600EDS-SV
05/23/06, 09:30	06/06/06, 08:00	6600EDS-SV
06/06/06, 08:30	06/28/06, 12:30	6600EDS-SV
06/28/06, 01:00	07/25/06, 11:30	6600EDS-SV
07/25/06, 12:30	08/14/06, 13:30	6600EDS-SV
08/14/06, 14:00	09/06/06, 09:30	6600EDS-SV
09/06/06, 10:00	09/29/06, 13:30	6600EDS-SV
09/29/06, 14:00	10/24/06, 13:00	6600EDS-SV
10/24/06, 13:30	11/03/06, 09:30	6600EDS-SV
11/03/06, 10:30	12/05/06, 14:00	6600EDS-SV
12/05/06, 14:30	12/21/06, 11:00	6600EDS-SV
12/21/06, 11:30	01/23/07, 13:30	6600EDS-SV

Head of Tide Site (site code: HT)

04/06/06, 12:00	04/27/06, 12:00	6600EDS
04/27/06, 12:30	05/18/06, 10:00	6600EDS
05/23/06, 12:00	06/09/06, 12:00	6600EDS
06/09/06, 13:00	07/03/06, 12:30	6600EDS
07/03/06, 13:00	07/28/06, 11:00	6600EDS
07/28/06, 11:30	08/24/06, 11:30	6600EDS
08/24/06, 12:00	09/12/06, 09:30	6600EDS
09/12/06, 10:00	10/10/06, 10:30	6600EDS
10/10/06, 11:00	11/07/06, 11:00	6600EDS
11/07/06, 12:00	12/06/06, 14:30	6600EDS
12/06/06, 15:00	01/03/07, 13:30	6600EDS

Skinner Mill Site (site code: SM)

04/14/06, 13:00	05/23/06, ????*	6600EDS
05/30/06, 09:30	06/22/06, 11:30	6600EDS
06/22/06, 12:00	07/17/06, 14:00	6600EDS
07/17/06, 15:00	07/27/06, 12:30*	6600EDS-SV
07/27/06, 12:45	08/14/06, 09:00	6600EDS-SV
08/14/06, 09:30	09/08/06, 13:30	6600EDS-SV
09/08/06, 14:00	10/06/06, 12:30	6600EDS-SV
10/06/06, 13:00	10/30/06, 10:30	6600EDS-SV
10/30/06, 11:00	11/29/06, 11:00	6600EDS-SV
11/29/06, 11:30	12/19/06, 14:00	6600EDS-SV
12/19/06, 14:30	01/16/07, 14:00	6600EDS-SV

* See notes in "other remarks/notes" section

Little River Mouth Site (site code: LM)

04/12/06, 16:00	05/04/06, 12:00	6600EDS
05/04/06, 13:30	05/23/06, ????*	6600EDS
05/25/06, 15:00	06/14/06, 09:00	6600EDS
06/14/06, 09:30	07/10/06, 13:00	6600EDS
07/10/06, 13:30	08/07/06, 13:00	6600EDS
08/07/06, 13:30	08/30/06, 09:30	6600EDS
08/30/06, 10:00	09/20/06, 10:30	6600EDS
09/20/06, 11:00	10/17/06, 09:30	6600EDS
10/17/06, 10:00	11/13/06, 13:00	6600EDS
11/13/06, 13:30	12/12/06, 10:30	6600EDS

12/12/06, 11:00 01/12/07, 12:00 6600EDS
*See notes in "missing data" and "other remarks/notes" sections

7). Distribution

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program:

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page <http://cdmo.baruch.sc.edu/>. Data are available in text tab-delimited format.

8). Associated researchers and projects

WELLS NATIONAL ESTUARINE RESEARCH RESERVE RESEARCH AT THE RESERVE for 2006
(Please visit our website: www.wellsreserve.org/research.htm for further information on the Wells NERR research program):

The Research Program at the Wells NERR conducts and supports research, monitoring, workshops, and research/resource management planning of relevance at local, regional and national levels. The overall aim of our work is to produce science-based information needed to sustain or restore Gulf of Maine coastal habitats and resources, especially those found in salt marsh estuaries and watersheds. During 2003-2004 many different studies involving scores of scientists, students, staff and volunteers focused on several related themes: 1) the quality of water resources in salt marsh estuaries and watersheds 2) land conservation strategies to protect coastal watersheds 3) factors controlling salt marsh accretion, erosion and plant community vigor 4) the value of salt marsh as habitat for fish, shellfish and birds, 5) restoration of salt marsh habitat degraded through human actions, and 6) understanding the ecology and functions of salt marsh habitat.

Estuarine Water Resource Quality

Water quality is monitored continuously at several stations with automated instruments as part of a NERRS systemwide monitoring program, as well as bimonthly at 15-20 stations through our WET volunteer monitoring program. The WET program also monitors two important biological parameters: fecal coliform bacterial contamination (an indicator of human health risk) and phytoplankton productivity (an indicator of estuarine health). These data have 1) allowed us to identify several bacterial "hot spots" that we will be working to eliminate, 2) are used to identify and open areas safe for shellfishing, and 3) have uncovered a relation between tides and low dissolved oxygen (a stressful condition for marine life) that needs further study. Our water quality work has contributed to the designation of several Priority Watersheds in coastal Southern Maine by the Maine Department of Environmental Protection.

NERRS System-Wide Monitoring Program

Meteorological and Nutrient data are also monitored under SWMP protocols. These data are available from the Research Coordinator or online at <http://cdmo.baruch.sc.edu/>.

Seacoast Watershed Information Manager (Project S.W.I.M.)

The Seacoast Watershed Information Manager (Project S.W.I.M.) will be an online resource to help local planners and the public evaluate, conserve, and restore coastal watershed resources along the Maine and New Hampshire seacoast by developing a website that describes the region and its resources, provides access to GIS data and other relevant information, and includes a decision-support tool that examines the impact of growth and development on water resources. It will include:

- A Narrative that informs local resource planners and the public by describing development impacts, water resources, and land use.
- Socioeconomic Analysis focused on water resource use as it relates to human activities.
- Land Use Change Assessments focusing on shoreland and permeability.
- A Data Clearinghouse providing users access to key data needed for local and regional-scale resource management.
- A GIS-based Decision Support Tool to help communities manage and protect water resources by considering how water supply, water quality and land use change are affected by land use planning decisions.

The Project focuses on the coastal watersheds from the Cocheco and Salmon Falls River in New Hampshire to the Kennebunk River in Maine. These 15 watersheds include 38 municipalities and cover 1,800 square miles. The Wells National Estuarine Research Reserve is the lead partner with support from NOAA's Coastal Services Center Landscape Characterization and Restoration Program and the Great Bay National Estuarine Research Reserve.

Salt Marsh Habitats and Communities

Factors that control the dynamics and vigor of salt marsh plant communities and marsh peat formation consequently determine the ability of a salt marsh to persist in the face of sea level rise. Through a combination of experimental manipulations and long term monitoring, a number of multi-year studies are currently producing data to answer questions concerning the sustainability of salt marsh habitats in this region. These studies are looking at nutrient-plant relations, plant community responses to physical and hydrologic disturbance, and the relative contribution of short-term natural events (e.g. storms) and human

activities (dredging, tidal restriction) on patterns of sediment accretion and erosion. The Reserve's marshes and beaches are already among the best studied sites in the U.S. with regard to long term accretion and erosion (over thousands of years).

HABITAT VALUE FOR FISH, SHELLFISH AND BIRDS

The Reserve combines long-term monitoring with periodic surveys and short-term experiments to identify species and measure trends and changes in populations of fish, crustaceans, clams and birds. We have 10 years of data on upland and shore birds with which to assess the status of resident and migratory avian populations, and several years of wading bird data that we use as a gross level indicator of salt marsh health, which appears to be stable. Our periodic larval, juvenile and adult fish surveys have produced the best available data for fish utilization of salt marsh estuaries in the Gulf of Maine. Since 1994 we have been conducting surveys and field experiments to look at the survival and growth of hatchery seed, juvenile and adult softshell clam with regard to habitat characteristics and predation by the invasive green crab. Benthic invertebrates have been sampled from a number of marshes from Wells to Casco Bay in hopes of gaining a better understanding of invertebrate assemblage and their value to higher trophic levels.

Salt Marsh Degradation and Restoration

Salt marsh ecosystems in the Gulf of Maine have sustained themselves in the face of sea-level rise and other natural disturbances for nearly five thousand years. Since colonial times large areas of salt marsh (up to half of the total area) have been lost through diking, draining and filling. Today, the remaining marshland is fairly well protected from outright destruction, but during the past 100 years, and especially since the 1950's, salt marshes have been divided into fragments by roads, causeways, culverts and tide gates. Most of these fragments have severely restricted tidal flow, leading to chronic habitat degradation and greatly reduced access for fish and other marine species. Since 1991, the Wells Reserve has been studying the impact of these restrictions on salt marsh functions and values, and the response of salt marshes to tidal restoration. We have been working to promote an awareness of the damage being done and the benefits of salt marsh restoration throughout the Gulf of Maine.

Research Program Update: In addition to the Reserve-sponsored projects outlined above, numerous visiting investigators will be involved in on-site research. Topics include: the effects of land use, sea level, and climate on estuarine productivity; the relationship between soil nutrients and plant community patterns; the influence of soil salinity on plant community interactions; the effect of tidal restriction on marsh peat accretion; the comparative ecology of fringe marshes and back barrier marshes; habitat use by upland birds, and the ecology of Lyme disease.

"Ecological Functions of Fringing Salt Marshes Susceptible to Oil Spills in Casco Bay, Maine". We examined the ecological function of 9 different fringing marsh systems in Casco Bay that ranged from undisturbed to disturbed. Physical parameters measured included sedimentation rates, total suspended solids, and tidal range. Biological parameters included primary production, macroinvertebrate community composition and secondary production (4cm sediment cores), and resident and transient nekton community composition (fyke net). The project is still under way.

The Wells NERR Research Department also worked on the following project: In partnership with the York Rivers Association and the Town of York, the Wells Reserve conducted a survey of the York River watershed. In this survey, volunteers looked for sources of pollution within a 250-foot buffer of the river and its tributaries (erosion, trash and debris and runoff from roads and lawns could have a negative impact on water quality). Most pollutants entering water bodies come from such undefined sources. Therefore, this type of survey is the best way to begin to address the problems of pollution in a water body. The idea of the project was to work with the community and landowners to help them understand the problems that come from these types of pollution and learn activities they might be able to do on their own land that would help prevent this pollution from entering the water. The results of the survey will become part of a Watershed Management Plan to improve and restore the water quality of the York River.

The Wells NERR Research Dept. is involved with the following CICEET* Projects:

Project Title: Estuarine Responses to Dredging: Analysis of Sedimentary and Morphological Change in Back Barrier Marsh to Aid Local Management and Develop a Regional Management Tool Principal Investigator (s): Michele Dionne, Wells NERR, ME; Duncan Fitzgerald, Boston University; Joe Kelley, University of Maine; David Burdick and Larry Ward, University of New Hampshire
Management Issue: Coastal management tool for assessing the impacts of dredging in estuaries. Project Summary: An adequate supply of sediment is essential for maintaining salt marshes. Human activities, such as channel dredging and tidal restriction due to road construction, can alter water flows in estuaries and result in dramatic changes in salt marsh sediment supply, affecting the speed of salt marsh erosion. The objective of this project is to determine the impact of dredging and tidal restriction on salt marshes in the Wells NERR. A digital coastal management guide will be created on CD ROM, providing coastal managers with useful conceptual models for predicting the impacts of dredging and other activities that affect water flow and sediment deposition in salt marshes.

June Ficker Project Title: Monitoring avian productivity and survivorship

Outside Researchers: Theresa Theodose, Ph.D., University of Southern Maine
Project Title: Relationships between soil nutrient availability and species composition of a high salt marsh in southern Maine.

David Burdick, Ph.D. and Roelof Boumans, Ph.D. University of New Hampshire, University of Maryland Project Title: Sediment dynamics in salt marshes: functional assessment of accretionary biofilters

Peter Rand, M.D., Chuck Lubelczyk, Robert Smith, M.D. Maine Medical Center
Project Title: Ecological determinants of the spread of the tick vector of Lyme disease and other pathogens.

II. Physical Structure Descriptors

9). Variable sequence, range of measurements, units, resolution, and accuracy; and Depth Qualifiers:

DEPTH QUALIFIER: The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either depth or water level sensors. Both sensors measure water depth, but by convention, level sensors refer to atmospherically vented measurements and depth refers to non-vented measurements. Readings for both vented and non-vented sensors are automatically

compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.03 cm for every 1 millibar change in atmospheric pressure, and is eliminated for level sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg). To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or Digital Calibration Log. This offset procedure standardizes each depth calibration for the entire NERR System. If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR site can be corrected. The Research Coordinator at the specific NERR site should be contacted in order to obtain information regarding atmospheric pressure data availability. WEL NERR uses both vented and non-vented depth sensors. The type of depth sensor is designated by sonde type (6600 EDS = non-vented, 6600EDS-SV = vented) and noted for each deployment in the Data Collection period section.

Sequence of both 6600EDS and 6600EDS-SV dataloggers:

Date, Time, Temperature, Specific Conductivity, Salinity, dissolved oxygen %, dissolved oxygen mg/L, Level (for water depth), pH, Turbidity, Battery voltage

NOTE: Chlorophyll data was also collected for the IN site from May 5, 2004, until the end of the year. CDMO has requested that the data not appear in our dataset. Please contact the Wells NERR directly for this data.

Following specifications for 6600EDS and 6600EDS-SV data loggers are taken from YSI 6-Series Environmental Monitoring Manual, Appendix M (undated).

Date

Sensor Type: NA

Range: 1-12, 1-31, 00-99 (Mo,Day,Yr)

Resolution: 1 mo, 1 day, 1 yr

Accuracy: NA

Time

Sensor Type: NA

Range: 0-24, 0-60, 0-60 (Hr,Min,Sec)

Resolution: 1 hr, 1 min, 1 s

Accuracy: NA

Temperature

Sensor Type: Thermistor

Range: -5 to 45 (c)

Resolution: 0.01 C

Accuracy: +/-0.15C

Depth: 200 m

Specific Conductivity

Sensor Type: 4 electrode cell with autoranging

Range: 0-100 (mS/cm)

Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependent)

Accuracy: +/-0.5% of reading + 0.001mS/Cm
Depth: 200 m

Salinity

Sensor Type: calculated from conductivity and temperature
Range: 0-70 ppt
Resolution: 0.01 ppt
Accuracy: +/-1.0% of reading or + 0.1 ppt whichever is greater

Dissolved oxygen, % saturation

Sensor Type: Rapid pulse - Clarke type, polarographic
Range: 0 - 500% air saturation
Resolution: 0.1% air saturation
Accuracy: 0-200% air saturation, +/-2% of the reading or 2% air saturation, whichever is greater; 200-500% air saturation, +/-6% of reading
Depth: 200 m

Dissolved oxygen, mg/L (calculated from % air saturation, temperature and salinity)

Sensor Type: Rapid pulse - Clarke type, polarographic
Range: 0 - 50 mg/L
Resolution: 0.01 mg/L
Accuracy: 0-20 mg/L, +/-2% of the reading or 2 mg/L, whichever is greater; 200-20-50 mg/L, +/-6% of reading
Depth: 200 m

Level for 6600EDS shallow (non-vented):

Sensor Type: stainless steel strain gauge
Range: 0 - 30 ft (9.1 m)
Resolution: 0.001 ft (0.001 m)
Accuracy: +/-0.06 ft (0.018 m)

Level for 6600EDS-SV:

Sensor Type: stainless steel strain gauge
Range: 0 - 30 ft (9.1 m)
Resolution: 0.001 ft (0.001 m)
Accuracy, 0-10ft: +/-0.01 ft (0.003 m)
Accuracy, 10-30ft: +/-0.06 ft (0.018 m)

pH

Sensor Type: Glass combination electrode
Range: 0-14 units
Resolution: 0.01 units
Accuracy: +/-0.2 units
Depth: 200 m

Turbidity (probe model 6136)

Sensor Type: Optical, 90 degree scatter, with mechanical cleaning
Range: 0-1000 NTU
Resolution: 0.1 NTU
Accuracy: +/- 5% of reading or 2 NTU (whichever is greater), relative to calibration standards
Depth: 66 m

Chlorophyll

Sensor Type: Optical, fluorescence, with mechanical cleaning
Range: 0-400µg/L Chl; 0-100 Percent Full Scale (%FS) Fluorescence Units

Resolution: 0.1 µg/L Chl; 0.1 %FS
Accuracy: No specifications provided
Depth: 66 m

10). Coded variable indicator and variable code definitions:

Site definitions:

Sampling Station: Inlet at Webhannet River Mouth, at Wells Harbor
Sampling Site Code: IN
Station Code: welinwq

Sampling Station: Head of Tide of Webhannet River
Sampling Site Code: HT
Station Code: welhtwq

Sampling Station: Little River Mouth (Merriland/Branch/Little River estuary)
Sampling Site Code: LM
Station Code: wellmwq

Sampling Station: Skinner Mill (on Merriland R, tributary to
Merriland/Branch/Little R estuary)
Sampling Site Code: SM
Station Code: welsmwq

File definitions: 3 letter NERR site code (WEL for Wells NERR); 2 letter YSI
deployment site code (see above); data type code (WQ for water quality), month,
day, year of deployment (ex: WELINWQ071406 = Webhannet Inlet water quality data
from 14 July 2006).

11). Anomalous/Suspect Data:

Please see the Post-deployment information provided in Section 14 for additional
notes regarding post-calibration and probe/sonde errors.

January:

Webhannet Inlet (IN) Site: There appears to be an anomaly with our DO readings
at this site **for the entire year.** A trend has appeared of very low DO readings
during the ebbing tide and hits a low for that tide right about and hour into
incoming tide then shoots back up to reasonable readings. This is not a probe
malfunction because the trend has been observed with different probes and
sondes, and the probe post-calibrated fine on many of the retrievals. A good
example of this anomaly can be seen in the following data from welinwq072506:

Station Code	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
welinwq	07/25/2006	12:30	15.5	047.48	30.9	083.7	06.9	4.40	07.5	0016
welinwq	07/25/2006	13:00	15.3	047.49	30.9	081.3	06.7	4.21	07.7	0004
welinwq	07/25/2006	13:30	15.4	047.46	30.9	070.8	05.9	3.97	07.8	0002
welinwq	07/25/2006	14:00	16.1	047.55	31.0	034.7	02.8	3.69	07.9	0002
welinwq	07/25/2006	14:30	17.1	047.66	31.1	028.5	02.3	3.38	07.9	0003
welinwq	07/25/2006	15:00	18.3	047.67	31.1	014.2	01.1	3.05	07.8	0004
welinwq	07/25/2006	15:30	19.3	047.62	31.1	011.7	00.9	2.75	07.8	0004
welinwq	07/25/2006	16:00	20.0	047.58	31.0	007.7	00.6	2.50	07.8	0004
welinwq	07/25/2006	16:30	20.6	047.56	31.0	003.6	00.3	2.33	07.7	0003
welinwq	07/25/2006	17:00	20.8	047.51	31.0	002.8	00.2	2.25	07.7	0002

welinwq	07/25/2006	17:30	20.9	047.47	31.0	002.6	00.2	2.25	07.7	0002
welinwq	07/25/2006	18:00	21.0	047.43	30.9	002.6	00.2	2.34	07.7	0002
welinwq	07/25/2006	18:30	21.0	047.42	30.9	002.5	00.2	2.49	07.7	0002
welinwq	07/25/2006	19:00	21.1	047.41	30.9	002.5	00.2	2.71	07.6	0002
welinwq	07/25/2006	19:30	18.2	046.46	30.2	098.9	07.8	2.98	08.0	0001
welinwq	07/25/2006	20:00	17.2	046.89	30.5	104.3	08.4	3.28	08.1	0001

Although we have no explanation for this trend we do believe it is an actual event and merits further investigation. This trend can be seen in the entire year's data from this site. Further questions regarding DO data from the Inlet site should be directed to the author of this document. Individual instances of suspect/ anomalous DO data for the Inlet site for each month is not listed do to the large amount of individual data points that could be considered suspect/anomalous.

Webhannet Inlet (IN) Site: All data from the period of 1/19/06 at 16:30 through 02/15/06 13:30 should be considered suspect due to the post calibrations records and instability of most of the data within the dataset. There were obvious depth and DO errors, and it looks as if pH and Turbidity were affected also. It has been undetermined what caused bad DO charge upon retrieval for three consecutive deployments, one of which was in-situ for no more than 10 days.

Webhannet Inlet (IN) Site: The following pH values are considered suspect. The values seem unstable compared to other data from this site. This could indicate sensor drift or probe error.

Welinwq 01/22/06 00:30 through 01/26/06 12:00

February:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of February.

Webhannet Inlet (IN) Site: The following turbidity data is suspect due to the isolated high value.

Welinwq 02/02/06 @ 09:00

Webhannet Inlet (IN) Site: All Do data from Feburary should be considered suspect due to the reoccurrence of high DO charge upon retrieval, however data looks reasonable. See the "post calibration notes" section.

March:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of March.

Webhannet Inlet (IN) Site: The following Turbidity data is suspect due to its isolated extremely high values. This data could be caused by an animal in the sonde guard and in front of the sensor, or a malfunction in the wiper parking. Post calibrations on this probe where slightly high (1.2 NTU's) but not enough to suspect probe malfunction.

Welinwq 03/22/06 20:00 through 03/24/06 06:00

Welinwq 03/27/06 05:30 through 04/02/06 22:00

April:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of April.

Webhannet Inlet (IN) Site: The following pH values are considered suspect. The values seem unstable compared to other data from this site. This could indicate sensor drift or probe error.

Welinq 4/22/06 01:30 through 4/23/06 09:30

Skinner Mill (SM) Site: All data for the 4/14/06 13:00 - 05/23/06 deployment are considered suspect. At some point the sonde and deployment tube were washed away by floodwaters (likely during the May storm event). The sonde was later retrieved but it is unclear when this event took place and where exactly the sonde was while collecting these data

May:

The large amount of suspect/anomalous (and missing) data for this month is due to a severe storm and associated coastal flooding that took place between the 10th and 17th of May 2006. Please see the "other remarks/notes" section for more information.

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of May.

Webhannet Inlet (IN) Site: The following pH values are considered suspect. The values seem unstable compared to other data from this site. This could indicate sensor drift or probe error.

Welinq 5/26/06 01:30 through 5/27/06 15:30 (all data)

Skinner Mill (SM) Site: All data for the 4/14/06 13:00 - 05/23/06 deployment are considered suspect. At some point the sonde and deployment tube were washed away by floodwaters. The sonde was later retrieved but it is unclear when this event took place and where exactly the sonde was while collecting these data.

Any and all data collected and retained within this dataset between May 13th and May 23rd should be considered "suspect" due to the extreme conditions (high water levels, currents, and debris) present during this period.

June:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of June.

Head of Tide (HT) Site: The following Turbidity spike is suspect.
06/08/06 04:30

Little River Mouth (LM) Site: The following DO data is considered suspect/anomalous due to the extremely low readings at high tides and rapid rises with dropping water levels. This trend is not seen throughout the year and may be an indication of probe error/drift.

Wellmq 06/22/06 00:00 through 06/26/06 19:30 (all data)

Skinner Mill (SM) Site: The following turbidity data is considered suspect due to the instability of the readings. There were some rain events during this period but we do not believe that the impact was enough to cause such spikes.
Welsmq 06/04/06 14:00 through 06/22/06 11:30

Webhannet Inlet (IN) Site: The following Temperature data is considered anomalous due to a 6 degree temperature drop in a half hour period.

Station	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
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welinwq	06/30/2006	22:00	17.3	047.06	30.7			2.69	07.2	0003
welinwq	06/30/2006	22:30	11.9	047.79	31.1	071.4	06.4	2.90	07.8	0001

Webhannet Inlet (IN) Site: The following Jump in pH is considered suspect/anomalous. There is no apparent cause for this change in pH during this time period.

Station Code	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
welinwq	06/03/2006	00:00	15.5	043.56	28.1	013.4	01.1	3.02	07.0	0010
welinwq	06/03/2006	00:30	15.4	043.40	28.0	017.8	01.5	3.26	07.0	0008
welinwq	06/03/2006	01:00	15.0	043.52	28.1	089.1	07.6	3.53	07.4	0010
welinwq	06/03/2006	01:30	14.5	044.16	28.5	097.9	08.4	3.79	08.0	0005

Webhannet Inlet (IN) Site: The following DO and pH data is considered suspect due to its departure from the usual "trends" seen at this sight, and evident in the surrounding data. Both pH and Do drop to very low levels for this site and remain there through out tidal changes.

Welinwq 06/25/06 10:30 through 06/27/06 08:30

July:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of July.

Head of Tide (HT) Site: The following isolated Turbidity spike is considered suspect and is most likely debris or an animal in front of the sensor. Post calibration was fine.

Welhtwq 07/12/06 @ 23:00 (0998)

August:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of August.

Head of tide (HT) Site:

DO data from the months of August through October- appears to be heavily influenced by monthly high tide events surrounding full/New moons (8/6 - 8/20, 9/7-9-20, and 10/6-10/21), and possibly the seasonal increase in water temperature as well. During these "extreme" tide events, this site experiences dramatic changes in salinity, depth, pH, and DO. The following DO data is considered suspect due to its variation and erratic change in value. Although post calibration of this probe showed slightly "jumpy" readings, the probe was not in error (98.9%), DO charge was acceptable (44.1), however one of the contacts did show some corrosion.

Welhtwq All DO data from 08/06/06 through 08/20/06

Skinner Mill (SM) Site:

The following DO data is considered suspect/anomalous due to its rapid increase to values higher than normally found at this site, as well as its general instability. Post calibration showed no errors.

Station Code	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH
welsmwq	08/16/2006	09:45	19.3	006.91	03.8	090.4	08.2	0.08	07.3
welsmwq	08/16/2006	10:00	19.2	007.50	04.2	097.2	08.8	0.06	07.3

welsmwq	08/16/2006	10:15	19.3	008.77	04.9	123.3	11.1	0.05	07.4
welsmwq	08/16/2006	10:30	19.4	008.45	04.7	116.7	10.4	0.04	07.4
welsmwq	08/16/2006	10:45	19.7	009.10	05.1	118.2	10.5	0.03	07.4
welsmwq	08/16/2006	11:00	20.1	008.16	04.6	135.0	11.9	0.01	07.3
welsmwq	08/16/2006	11:15	20.2	009.69	05.5	131.3	11.5	0.00	07.5
welsmwq	08/16/2006	11:30	20.4	008.34	04.7	136.8	12.0	-0.01	07.5
welsmwq	08/16/2006	11:45	20.8	007.74	04.3	134.8	11.8	-0.01	08.0
welsmwq	08/16/2006	12:00	21.1	008.21	04.6	139.9	12.1	-0.02	07.9
welsmwq	08/16/2006	12:15	21.4	008.11	04.5	150.7	13.0	-0.03	07.9
welsmwq	08/16/2006	12:30	22.1	007.40	04.1	149.0	12.7	-0.04	07.9
welsmwq	08/16/2006	12:45	21.9	008.12	04.5	148.2	12.6	-0.04	08.2
welsmwq	08/16/2006	13:00	22.5	007.57	04.2	141.3	12.0	-0.05	07.9
welsmwq	08/16/2006	13:15	22.5	007.48	04.1	133.2	11.3	-0.05	07.7
welsmwq	08/16/2006	13:30	23.0	007.55	04.2	154.8	13.0	-0.06	07.9
welsmwq	08/16/2006	13:45	23.3	007.34	04.1	170.9	14.2	-0.06	08.1
welsmwq	08/16/2006	14:00	23.3	008.93	05.0	176.1	14.6	-0.06	08.5
welsmwq	08/16/2006	14:15	21.9	015.20	08.9	188.4	15.7	-0.01	08.6
welsmwq	08/16/2006	14:30	19.9	018.21	10.8	157.2	13.4	0.07	08.4
welsmwq	08/16/2006	14:45	19.1	025.48	15.6	155.8	13.2	0.21	08.2
welsmwq	08/16/2006	15:00	19.1	028.71	17.8	142.7	11.9	0.39	08.2
welsmwq	08/16/2006	15:15	20.0	026.05	16.0	137.9	11.4	0.61	08.2
welsmwq	08/16/2006	15:30	19.8	027.97	17.3	132.5	10.9	0.82	08.2
welsmwq	08/16/2006	15:45	20.4	025.05	15.3	133.2	11.0	1.00	08.2
welsmwq	08/16/2006	16:00	18.6	035.09	22.2	131.9	10.8	1.13	08.1
welsmwq	08/16/2006	16:15	18.1	042.20	27.2	122.3	09.8	1.22	08.0

Skinner Mill (SM) Site: The following isolated turbidity spikes are considered suspect. There were no significant rain events to explain these extremely high isolated spikes.

Welsmwq 08/14/06 09:15 through 08/18/06 09:00 (all values >200)
 08/20/06 02:00 and 16:15
 08/21/06 00:15 and 00:45
 08/22/06 23:30
 08/27/06 14:00 and 17:15

Webhannet Inlet (IN) Site: The following DO and pH values are considered suspect due to their departure from normal trends seen at this site. Readings bottom out at very low values and remain that way throughout tidal cycles.

Welinwq 08/03/06 11:00 through 08/07/06 18:00

September:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of September.

Head of tide (HT) Site: DO data from the months of August through October- appears to be heavily influenced by monthly high tide events surrounding full/New moons (8/6 - 8/20, 9/7-9-20, and 10/6-10/21), and possibly the seasonal increase in water temperature as well. During these "extreme" tide events, this site experiences dramatic changes in salinity, depth, pH, and DO. The following DO data is considered suspect due to its variation and erratic change in value.

The following DO data from our Head of Tide (HT) site, is considered suspect due to its isolated drop in value:

Station	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
welhtwq	09/02/2006	17:30	15.5	000.24	00.1	097.5	09.7	0.70	07.1	0002
welhtwq	09/02/2006	18:00	13.5	000.66	00.3	056.6	05.9	0.68	06.7	0001
welhtwq	09/02/2006	18:30	14.6	001.43	00.7	079.2	08.0	0.76	06.7	0005

Head of Tide (HT) Site:

The following DO data is considered suspect due to its rapid drop and rebound to reasonable readings. The probe area may have been affected by something inside the guard, etc.

Station	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
welhtwq	09/02/2006	17:30	15.5	000.24	00.1	097.5	09.7	0.70	07.1	0002
welhtwq	09/02/2006	18:00	13.5	000.66	00.3	056.6	05.9	0.68	06.7	0001
welhtwq	09/02/2006	18:30	14.6	001.43	00.7	079.2	08.0	0.76	06.7	0005
welhtwq	09/02/2006	19:00	15.7	002.91	01.5	096.1	09.5	0.58	06.9	0003

Head of Tide (HT) site: The following DO data is considered suspect due to a sharp increase in value. This could be associated with the change in water level seen in the data as well.

Station	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
welhtwq	09/13/2006	13:30	14.4	020.46	12.3	059.9	05.7	0.26	06.9	0002
welhtwq	09/13/2006	14:00	14.4	020.25	12.1	060.2	05.7	0.55	06.8	0002
welhtwq	09/13/2006	14:30	15.9	020.44	12.3	084.3	07.7	0.73	07.0	0003
welhtwq	09/13/2006	15:00	16.7	023.26	14.1	099.2	08.9	0.83	07.1	0004
welhtwq	09/14/2006	15:30	14.3	017.76	10.5	052.6	05.1	0.55	06.8	0002
welhtwq	09/14/2006	16:00	16.2	018.31	10.9	080.0	07.4	0.69	06.9	0003
welhtwq	09/14/2006	16:30	17.4	020.26	12.1	096.1	08.6	0.73	07.0	0004

Skinner Mill (SM) Site: The following DO data is considered suspect. The data is unstable and values rapidly rise and fall for no apparent reason.

Welsmwq 09/09/06 07:30 through 09/12/06 13:30 (all data)

Skinner Mill (SM) Site: The following DO data is considered suspect. The values climb quite high in some cases and is not representative of "normal" DO readings at this site.

Station	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
welsmwq	09/26/2006	09:15	14.2	004.85	02.6	103.7	10.5	0.05	07.3	0003
welsmwq	09/26/2006	09:30	14.5	004.84	02.6	111.7	11.2	0.05	07.4	0004
welsmwq	09/26/2006	09:45	14.7	004.74	02.6	117.6	11.7	0.04	07.5	0005
welsmwq	09/26/2006	10:00	15.0	004.90	02.6	128.0	12.7	0.04	07.7	0006
welsmwq	09/26/2006	10:15	15.2	004.46	02.4	130.0	12.9	0.03	07.8	0006
welsmwq	09/26/2006	10:30	15.7	007.80	04.3	185.2	17.9	0.04	08.3	0011
welsmwq	09/26/2006	10:45	14.8	023.08	14.0	155.2	14.4	0.09	08.3	0005
welsmwq	09/26/2006	11:00	14.8	025.11	15.3	173.2	16.0	0.16	08.5	0005
welsmwq	09/26/2006	11:15	14.2	033.46	21.0	122.0	11.0	0.28	08.1	0003
welsmwq	09/26/2006	11:30	14.6	023.48	14.3	128.2	12.0	0.43	08.3	0005
welsmwq	09/26/2006	11:45	14.8	021.08	12.7	112.1	10.5	0.62	07.9	0004
welsmwq	09/26/2006	12:00	14.9	022.29	13.5	102.0	09.5	0.79	07.7	0003

welsmwq	09/26/2006	12:15	14.9	021.68	13.1	100.0	09.3	0.95	07.7	0003
welsmwq	09/26/2006	12:30	15.0	021.06	12.7	098.5	09.2	1.07	07.7	0003

Webhannet Inlet (IN) Site: The following Turbidity data is considered suspect. Although there was significant rain around these dates, the values seem very unstable and erratic, as well as the Inlet site not usually being affected by rain events due to its depth and location in an open harbor as opposed to a river or creek like our other stations which show the effects of rain quite readily due to runoff and their relatively small size.

Welinq 09/04/06 07:30 through 09/06/06 10:00

Welinq 09/26/06 22:00 through 09/29/06 13:30

Little River Mouth (LM) Site: The following turbidity data is considered suspect. Although there were rain events during this time period, it seems as if the sensor either experienced some kind of fouling or something within the guard of the sonde as readings fluctuate in the low hundreds with occasional spike to 2000 plus (all data >1000 was deleted as absolute rejection). Bad post calibration as well.

Wellmwq 09/12/06 07:30 through 09/20/06 11:00

October:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of October.

Webhannet Inlet (IN) Site: Turbidity spikes at the following dates/times are suspect. It's possible that something was blocking the optic.

10/22/06 15:30 (901 NTU)

10/23/06 11:30 (901 NTU)

10/23/06 13:00 (901 NTU)

Head of tide (HT) Site:

DO data from the months of August through October- appears to be heavily influenced by monthly high tide events surrounding full/New moons (8/6 - 8/20, 9/7-9-20, and 10/6-10/21), and possibly the seasonal increase in water temperature as well. During these "extreme" tide events, this site experiences dramatic changes in salinity, depth, pH, and DO. The following DO data is considered suspect due to its variation and erratic change in value.

Skinner Mill (SM) Site: The following Turbidity data is considered suspect. Readings suddenly jump to very high numbers and readings are very erratic and unstable.

Welsmwq 10/28/06 19:00 through 10/30/06 10:30

November:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of November.

Webhannet Inlet (IN) Site: The following DO data is suspect. The data suddenly departs from the usual trends seen at this site and described in the above paragraph. Numbers drop to very low readings and remain there for the remainder of the deployment.

Welinq 11/15/06 11:15 through 11/30/06 23:30

Skinner Mill (SM) Site: The following Turbidity data are considered suspect. Readings suddenly jump to very high numbers and readings are very erratic and unstable.

Welsmwq 11/14/06 11:30 through 11/29/06 11:00

December:

Webhannet Inlet (IN) Site: See note from January for information regarding Anomalous DO data from the Webhannet Inlet (IN) site for the month of December.

Skinner Mill (SM) Site: The following isolated turbidity spikes are considered suspect/anomalous.

Welsmwq 12/26/06 at 21:45

Welsmwq 12/30/06 at 22:45

Webhannet Inlet (IN) Site: The following DO data is suspect. The data suddenly departs from the usual trends seen at this site and numbers drop to very low readings and remain there for the remainder of the deployment.

Welinwq 12/01/06 00:00 through 12/05/06 15:00

Little River Mouth (LM) Site: The following drop in do data is considered suspect/anomalous.

Station	Date	cTime	Temp	SpCond	Sal	DO_pct	DO_mgl	Depth	pH	Turb
wellmwq	12/12/2006	10:30	02.5	004.33	02.3	103.7	13.9	0.38	07.2	0003
wellmwq	12/12/2006	11:00	02.7	003.71	01.9	070.3	09.4	0.14	06.9	0004
wellmwq	12/12/2006	11:30	02.8	003.04	01.6	104.7	14.0	0.12	07.3	0004

Little River Mouth (LM) Site: The following DO data is considered suspect due to its sudden drops in value accompanied by periods of anoxic conditions which are unusual for this site. This deployment is missing Post calibration data so this may be probe error.

Wellmwq 12/15/06 00:00 through 12/17/06 07:30

Little River Mouth (LM) Site: Depth data are unusually low for the 12/12/06 11:00 - 12/31/06 23:30 deployment. There were extreme low tides during this period that may have also resulted in probe displacement to some degree.

12). Deleted data:

All deleted data that is not listed here is deleted due to readings being out of the specifications of the probes. This data is considered "absolute rejection" and was deleted from the files before upload into our database. Each instance was not included here due to the large amount of individual negative depth and DO readings, as well as Turbidity readings greater than 1000, from multiple sites. Any questions regarding deleted or missing data should be directed to the author of this document.

Little River (LM) Mouth Site: The following DO data was deleted due to a torn membrane during deployment.

Wellmwq 4/12/06 16:00 to 05/04/06 12:00

Little River (LM) Mouth Site: The following data was deleted due to the sonde being uplifted by Ice and removed from its location.

Wellmwq 12/17/06 08:00 through 12/31/06 23:30

Little River Mouth (LM) Site: The following DO data was deleted due to a probe malfunction.

Wellmwq 6/26/06 20:00 through 7/10/06 13:00

Little River (LM) Mouth Site: Numerous negative depth values were deleted for the following dates/times. The depth probe was out of the water and affected by barometric pressure, while the remaining probes were still submerged.

Wellmwq 04/15/06 - 04/19/06

Wellmwq 07/05/06

Wellmwq 07/28/06 - 08/20/06

Wellmwq 09/18/06 - 09/29/06

Wellmwq 10/20/06

Wellmwq 12/13/06 - 12/31/06

Skinner Mill (SM) Site: All data from 05/14/06 @ 02:30 through 05/30/06 at 09:00 was deleted and not included in this data set as the sonde was removed by flood waters and readings are unstable, inaccurate, and not reflective of conditions at the Skinner Mill Site.

Skinner Mill (SM) Site: the following DO data was deleted do to a probe malfunction. The readings were very low and surrounded by data which met the criteria for absolute rejection.

Welsmwq 04/23/06 00:30 through 05/14/06 02:00

Skinner Mill (SM) Site: Numerous negative depth values were deleted for the following dates/times. The depth probe was out of the water, while the remaining probes were still submerged.

Welsmwq 08/03/06 - 09/08/06

Webhannet Inlet (IN) Site: The following turbidity data was deleted due to a probe/wiper malfunction.

Welinwq 02/19/06 16:00 through 03/06/06 15:30

Welinwq 09/30/06 03:00 through 10/20/06 08:30

Webhannet Inlet (IN) Site: The following DO data was deleted due to a probe malfunction and bad post calibrations

Welinwq 03/01/06 05:30 through 03/06/06 15:30

Head of Tide (HT) Site: Numerous negative depth values were deleted for the following dates/times. The depth probe was out of the water, while the remaining probes were still submerged.

Welhtwq 04/14/06 - 04/27/06

Welhtwq 06/09/06 12:30

Head of Tide (HT) Site: All parameters were deleted for the following dates/times. The sonde was out of the water due to low tide.

04/27/06 12:30

10/10/06 11:00

13). Missing data:

Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. For more details on deleted data, see the Deleted Data Section (12.). If additional information on missing data are needed, contact the Research Coordinator at the reserve submitting the data.

There is a large portion of data missing from the month of may for the Skinner Mill (SM), Little River (LM), and Head of Tide (HT) sites. This was due to a catastrophic storm event described in the "remarks/notes" section of this document. In addition, all data for the LM 5/4 - 5/23 deployment are missing due to a collection interval setup problem with the sonde.

Head of Tide (HT) Site: Data is missing from 05/18/06 at 10:30 through 05/23/06 at 11:30. we were unable to redeploy this site until the 23rd of May due to the increased Water levels and debris and current in the river itself.

Head of Tide (HT) Site: Data is missing from 7/16/06 13:30 through 7/28/06 11:00 due to a battery failure. Battery volts were ample upon deployment.

Skinner Mill (SM) Site: There is a large chunk of missing data from 07/17/2006 at 14:30 through 07/27/2006 at 12:30 due to an incorrect interval setting on the sonde. The interval was set to 15 hours as opposed to 15 minutes, therefore much to all of the data from this time period was missing and it was decided to leave this minimal data set out of our final submission.

14). Post deployment information

End of Deployment "post-calibration" readings in the following standard solutions:

DO% is recorded in calibration cup with few millimeters of water and two tiny sponges in bottom (saturated air).

SpCond (specific conductivity) solution is 10 mS/cm.

pH solution is 7.0

turb (turbidity) is recorded in deionized water (pre-deployment calibrated to 0.0).

site	Date	SpCond	DO%	DOchg	level	pH	Turb
IN	1/5/2006	10.02	106.1	99.6	0.611	7.21	0.4
IN	01/19/06	9.99	100.8	99.2	-4.525	6.96	0.8
IN	02/02/06	9.94	79.5	99.2	24.389	7.2	4.8
IN	02/15/06	10.04	111.9	99.2	0.002	6.95	1
IN	03/06/06	9.78	128.3	96.8	-0.007	7.05	1.6
IN	04/24/06	10.09	112.90	99.2	-0.011	7.05	1.2
IN	05/23/06	9.73	117.2	68.6	-0.002	7.01	4.2
IN	06/06/06	10.00	91.2	40	0	7.05	0.6
IN	06/28/06	9.68	104.5	50.2	0.043	7.04	0.2
IN	07/25/06	9.87	74.3	25.7	0.001	7.04	-0.1
IN	08/14/06	9.98	95.6	100.2	0.001	7.04	0.8
IN	09/06/06	9.97	114.6	99.2	0	7.03	-0.1
IN	09/29/06	10.03	97.9	48.2	-0.04	6.97	4.4
IN	10/24/06	10.02	107.4	69.6	-0.124	7	-0.9
IN	11/03/06	9.97	101.5	35.9	0.001	6.96	0
IN	12/05/06	10.17	106.1	44.1	-0.004	7.05	0.1
IN	12/21/06	10.19	99.6	47.1	-0.001	7.04	-0.2
IN	01/23/07	10.17	97.8	44.1	0	7.04	-0.2

NOTES on IN post deployment information:

There was a general trend of bad DO charges and values on post deployment calibration for this site. The reason for this is unclear as all sondes were properly calibrated before deployment and some had bad DO post cal info after only 10 days in the water. We also had two major depth malfunctions at the start of the year. Again, sondes were properly calibrated and somehow were either damaged or malfunctioned in the field.

1/19/06: Post calibration numbers are really bad here. Internal sonde error
 02/02/06: high DO charge and low DO%??? Depth sensor malfunction!!!
 02/15/06: high do charge
 04/24/06: high DO charge, EDS Brush found at bottom of cup
 06/28/06: pH slope a little low, last deploy
 08/14/06: high DO charge
 09/06/06: DO probe error
 10/24/06: low pH slope, last deploy
 12/05/06: a lot of crabs (10-15) in deployment tube, DO probe malfunction

Site	Date	DO %	DO		mS/cm	pH	NTU
			Charge	Depth			
HT	4/27/2006	100.2	48.2	-0.047	9.969	7.03	1.2
HT	5/18/2006	103.6	57.4	-0.152	9.976	7.05	-0.3
HT	6/9/2006	97.2	58.4	-0.079	9.94	6.98	0.1
HT	7/3/2006	100.7	49.2	0.025	9.998	6.84	-0.7
HT	7/28/2006	100.2	53.3	-0.021	9.876	7.03	0.4
HT	8/24/2006	98.6	44.1	0.029	9.976	7.06	0
HT	9/12/2006	102.4	51.2	0.097	10.13	7.11	0.1
HT	10/10/2006	94.1	49.2	0.022	10.01	7.06	0
HT	11/7/2006	103.7	51.2	0.065	9.989	7.02	0.2
HT	12/6/2006	101.8	43.1	-0.068	10.04	7.32	0.9
HT	1/3/2007	101.5	47.1	-0.066	9.987	7.03	-0.1

Notes on HT post deployment information:

05/18/06: Sonde found downstream after heavy flooding, EDS brush lost.
 07/28/06: batteries dead upon retrieval, stopped logging on the 16th
 08/24/06: Do readings were a little jumpy during post calibration. One electrode required sanding.

Site	Date	DO %	DO		mS/cm	pH	NTU
			Charge	Depth			
LM	5/4/2006	-48.8	1.2	-0.086	9.923	7.05	0
LM	05/23/06						
LM	6/14/2006	99.7	51.2	0.008	10.03	7.01	-0.2
LM	7/10/2006	84.6	52.3	0.006	10.02	6.89	0
LM	8/7/2006	94.7	46.1	0.007	10.01	7.08	0
LM	8/30/2006	97.8	47.1	-0.015	9.875	7.06	0.3
LM	9/20/2006	98.7	42	-0.144	9.988	7.06	0.5
LM	10/17/2006	100	49.2	0.091	10.08	7.17	0
LM	11/13/2006	99.9	51.2	0.062	10.17	6.97	-0.1
LM	12/12/2006	105.7	46.1	0.217	10.07	7.09	-0.6
LM	1/12/2007						

NOTES on LM post deployment information:

The two yellow areas represent sonde damage where post calibration was not able to be performed due to lack of communication between the CPU and sonde.

05/04/06: DO probe malfunction early in deployment
 5/23/06: found 100+ yards downstream from original place. Sonde damaged, unable to download data or do post calibrations.
 07/10/06: low DO on post cal, probe required sanding
 09/20/06: some sand in and around sonde.
 1/12/07: Sonde removed by ice and not found until week later. No post cal info

site	Date	SpCond	DO%	DOchg	level	pH	Turb
SM	05/23/06	9.88	-0.7	3.2	-0.073	7.14	0.4
SM	06/22/06	9.95	104.7	55.3	0.027	7.01	-0.2
SM	07/17/06	9.98	99.7	47.1	-0.023	6.89	-0.2
SM	07/27/06	10.00	99.6	43.1	0.001	6.98	0.4
SM	08/14/06	9.95	109.40	34.9	-0.001	7.05	0
SM	09/08/06	9.95	101.3	39	0	6.96	0.2
SM	10/06/06	9.89	101	38	0.001	7.13	0.6
SM	10/30/06	10.01	105.2	48.2	-0.004	6.97	0.1
SM	11/29/06	9.87	101.6	???	0.011	7.04	0
SM	12/19/06	10.05	102	53.3	0	7.08	0.1
SM	01/16/07	10.07	99.4	51.2	-0.006	7.09	0

NOTES on SM post deployment information:

05/23/06: Last deployment at "old" skinner mill site, logger retrieved on 5/23 after severe coastal flooding. (see notes in "other remarks" section)
 06/22/06: 1st deployment at the "new" Skinner Mil Site, future telemetry site.
 07/17/06: 1st deploy hooked up to telemetry station
 07/27/06: set interval to 15 hours by accident! A lot of missing data here. 1st vented depth readings from this site.
 10/30/06: heavy sediment in sonde guard possibly from rain event on 10/28

15). Other Remarks/Notes:

On 10/02/2019 this dataset was updated to include embedded QAQC flags for anomalous/suspect data. System-wide monitoring data beginning in 2007 were processed to allow for QAQC flags and codes to be embedded in the data files rather than detailed in the metadata alone (as in the anomalous/suspect, deleted, and missing data sections above). Prior to 2006, rejected data were deleted from the dataset so they are unavailable to be used at all, but suspect data were only noted in the metadata document. Suspect data flags <1> were embedded retroactively in order to allow suspect data to be easily identified and filtered from the dataset if desired for analysis and reporting purposes. No other flags or codes were embedded in the dataset and users should still refer to the detailed explanations above for more information.

Data from the Inlet site from 2/2/06 @ 14:00 through 2/15/06 @ 11:30 is non-vented depth readings. There was no shallow vented sonde to deploy due to maintenance issues.

Three of our four sites (SM, LM, and HT) are discontinued through the winter months due to icing in the rivers. See section 6 data collection period for times of site deployment.

Webhannet Inlet (IN) site: There was an anomalous trend happening at our IN site for the entire year (See section 11 for example). A trend has appeared of very

low DO readings during the ebbing tide and hits a low for that tide right about and hour into incoming tide then shoots back up to reasonable readings. This is not a probe malfunction because the trend has been observed with different probes and sondes, and the probes post-calibrated fine on most of the retrievals. Although we have no explanation for this trend we do believe it is an actual event and merits further investigation. This trend can be seen in the entire year's data. Further question regarding DO data from the Inlet site should be directed to the author of this document.

Head of Tide (HT) Site: The majority of the negative depth readings at this site (deleted data) were probably a result of the depth probe being out of the water while the other probes remained submerged. This site experiences low water levels at times and could be the cause of the negative depth readings.

On the week of 5/10/06 there was a severe coastal storm which dropped over 6 inches of rain on the 13th alone and a total of just over 13 inches of rain in a 72 hour period, breaking state records. Any data from this period and the week following should be viewed carefully before its use. Readings from this time period are very different from those normally seen at these locations. In some cases, the stations were not able to be re-deployed until many days after the initial rain events due to storm water, debris, and closed roads and bridges.

The following rain events are considered significant and are visible in the corresponding data sets. The parameters affected most are turbidity, pH, and depth. However, there may be other changes in the aforementioned parameters (and others) which were effected by smaller rain events **NOT** listed below.

March 13-14th

April 4th-5th

May 2nd

May 9th-16th (see note above)

June 3rd and 7th

July 21st-22nd

October 11th-12th

Skinner Mill (SM) site: This was a very low water site with rocky substrate which prevented the installation of a fixed, vertical pole in the stream. Consequently, deployment of the logger occurred in a horizontal PVC tube, with sensors 18-26 cm from stream bottom (depending on their location on the sonde). Every attempt was made to place and anchor the deployment tube in the same spot at each deployment. However, it is possible that unusual deployment conditions resulted in the sonde being in slightly different locations. In addition, high water flow or debris in the water column may have caused the deployment tube to shift during deployment. As a result, it is important to note when the logger was switched (see section 6 for discrete deployment times, across which depths may not correlate precisely). This site was switched to a more suitable head of tide/estuary scenario after the May flooding which occurred between 5/10/06 and 5/17/06. Please see the research methods and site selection and character sections for more information.